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STUDIES ON THE STATUS OF POLLUTION IN CERTAIN ESTUARINE AREAS IN KAKINADA

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ABSTRACT

The B O D levels and saprotrophication of two stations in an estuarine habitat at Kakinada was studied during one full tidal cycle. Both the stations were found to be heavily polluted by sewage with B O D values ranging between 10.8 and 12.8 ppm at the commercial canal (station 1) and between 4.8 and 8.8 ppm at the mangrove creek (station - 2). Tides did not seem to have much influence on the dilution of the pollutants. Based on planktonic indicator species observed and saprobity Index which worked out to be 2.75, both the sampling areas are considered as heavily polluted alpha-mesosaprobic zones.

INTRODUCTION

A pollutant may be simply and qualitatively defined as an unnatural and obnoxious substance that is related to the environment (Bridgwater and Mumford, 1979). The polluting strength of an effluent is usually expressed as the 5 day biochemical oxygen demand (B O D).

Sewage and industrial wastes containing significant amounts of putrescibile organic matter will exert B O D. As a matter of fact, the higher the putrescible organic matter the higher the B O D.

Estuaries have very complex flow patterns, in some the water merely moves up and down the estuary with the tidal motion and very slow seaward travel takes place, so that dilution is correspondingly slow (Royal commission on Environmental Pollution, 1972).

Based on earlier observations Liebmann (1962) noticed that

certain organisms show a certain relation to the purity or respective pollution of water. A comprehensive review of the systems of biological indicators for water quality assessment was given by Persoone and De Pauw (1979). Saprotrophication is rather a newly coined term (Zutshi, 1981) referring to the condition (saprobity) caused by entry of raw sewage or animal filth or both into a body of water.

In the present study, levels of B O D qualitative study of plankton to find the presence or absence of indicator species based on their saprobic nature as outlined by Persoone and De pauw (1979) were studied.

MATERIALS AND METHODS

This study was conducted at the estuarine areas around the C.F.E.T.C., at Kakinada (Lat. 16° 50' 4" N and Long 82° 15' 45" E. Elevation 0.87 m above MSL) in the East Godavari district of Andhra Pradesh.

The commercial canal under study is used for the transportation of goods like rice bran, fertilizers, machinaries etc., in small wooden and mechanised boats. Effluent waste water pipe lines from the city sewage also empty their polluted sewage water into the commercial canal. Diesel oil and grease from mechanised fishing boats are also discharged into the water and make a thin film of oil on water surface.

Two stations were selected for the study (i) the ferry yard on the wharf road side of the commercial canal, (ii) mangrove creek behind the main sluice gate of B.W.F.F., which is connected to the backwaters of Kakinada Bay. (Fig.1).

Water samples were collected simultaneously from the two stations at 6 hourly intervals from 1100 hrs. on the 28th to 1100 hrs. on the 29th December, 1987. Plankton samples were collected each time by filtering 50 ℓ water through 1/16" mesh plankton net and immediately preserved in 4% neutral formalin. Quantitative and qualitative estimation of plankton species was made using a Sedgwick rafter cell.

The method of analysis of biochemical oxygen demand was that of APHA (1975) and Golterman *et al.* (1978). Dilution water was obtained from the same canal 2 km upstream above the outfall following the method of Basu (1970). Seeding was not done as suggested by APHA (1975) and dilution was fixed

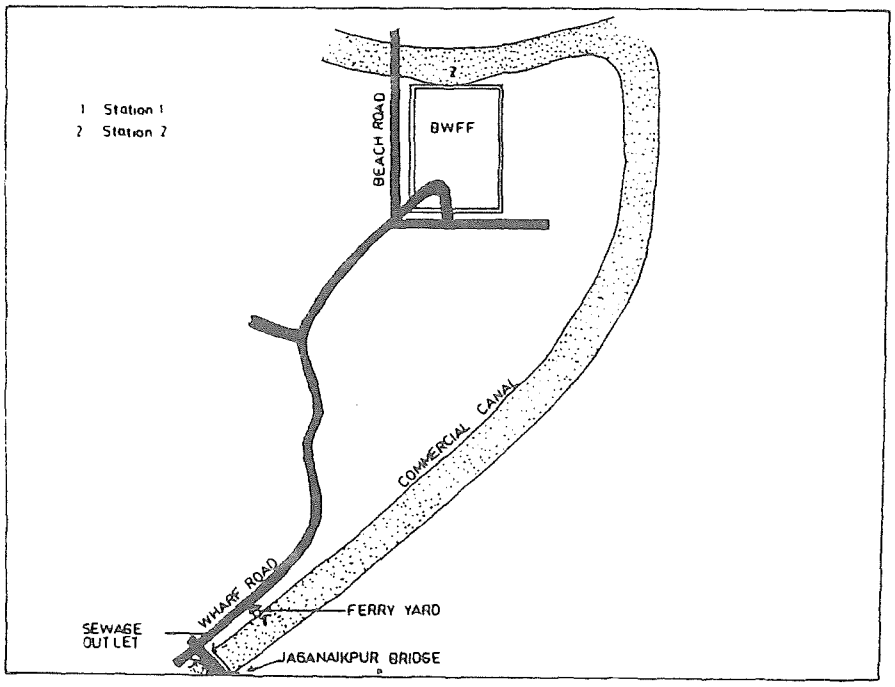

Fig.1 : Diagrammatic map showing the study area

at 50% since the sample was from polluted riverine sources for which a dilution of 25-100% has been recommended by APHA (1975). At each station three samples were collected each in a 300 ml B O D bottle. One sample was used to measure pH and dissolved oxygen (DO) level. Rest of the two samples were diluted at decided percentage and after 15 minutes DO was measured from one bottle. Another bottle was incubated for 5 days.

DO was estimated in all the cases by Winkler's modified titrimetric method (APHA, 1975). B O D was calculated by using the formulae (APHA, 1975),

$$\text{B O D mg/l (=ppm)} = \frac{D_1 - D_2}{P}$$

whereas D_1 = DO of diluted sample after 15 minutes,
D_2 = DO of diluted sample after 5 days incubation and
P = Percentage dilution.

Saprobic indicators were identified according to Persoone and De Pauw (1979) and the saprobic index was calculated

by the method of Pantle and Buck (1955).

RESULTS AND DISCUSSION

It is clearly evident from the present data (Fig. 2) that station I is highly polluted as the B O D values are always above 10.0 ppm. This waterbody comes under the 'bad' category as per the classification of the 8th report of the Royal Commission (Basu 1970); station 2 on the other hand is classified as one between "doubtful" and 'bad'.

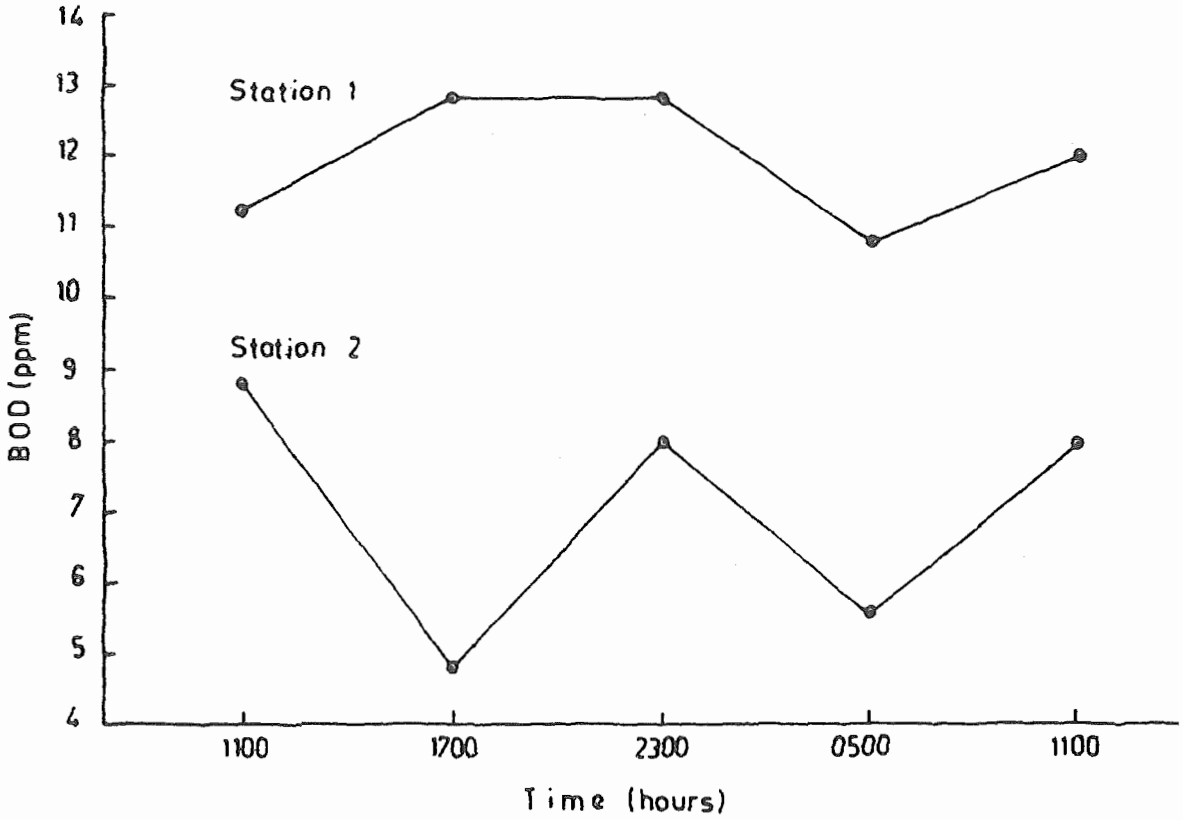

Fig.2 : Variations in BOD Value at the two stations.

Tides are shown to influence the diel fluctuations of various physioco-chemical and biotic parameters in the estuarine areas. (Qasim and Gopinathan, 1969; Bhargava, 1973; Vijayalakshmi and Venugopal, 1973; Bhargava and Dwivedi, 1974 and Ram *et al.* 1984). The influence of abiotic and biotic components on a daily basis in the commercial canal at Kakinada was shown by Mahapatra and Dash (1987). The present study however shows higher B O D value synchronising with high tides. Tidal influence is found to be very slow in improving the B O D as the variations at any given sampling station at different tidal levels were minimal. While the relatively lesser amount of B O D at station 2 can be attributed to it being away from

the outfall. The observed fluctuations at both stations, however, did not coincide much with the tidal conditions.

On the other hand there is scope for suspected transport of effluents upstream. Nothing is known about the flow patterns in these waters but it seems reasonable to assume that they are complex and render the dilution very slow corresponding to the slow seaward travel of effluents, as suggested by the Royal Commission of Environmental Pollution (1972).

A few saprobic indicators have been observed. Diatoms are the most abundant phytoplankton; of this *Nitschia* is an indicator of mesosaprobic waters. Association of *Nitszchia*, *Navicula* and *Gyrosigma* indicates alkaline waters (Kamat, 1981).

Naricula is cited as an indicator of waters containing oil and wastes producing hydrogen sulfide; all the above 3 diatoms together with *Phormidium* are indicative of wastes containing salt (Kamat, 1981). *Phormidum* is an indicator of mesosaprobic waters (Patrick, 1977).

Diatoms are not present in the polysaprobic zone where oxygen is completely depleted; however, in the mesosaprobic zone which is also polluted but where oxygen is not completely depleted *Nitzchia* and other diatom occur (Kamat, 1981; Zafer, 1981).

Among the zooplankton, which occurred abundantly, the ciliates (represented here by *Mesodinium* sp are an important group leaching to saprotrophication *Ceratium* sp which also occured abundantly, is an odour causing protozoan and indicates sudden shifts to the alpha mesosaprobic conditions due to organic enrichment and other favourable environment growth factors (Khan and Rao, 1981).

It is clear from the B O D values and the quality and quantity of plankton that the waters at station-1 can be included under the heavily polluted category of alpha-mesosaprobic zone and at station -2 in the 'intermediate zone' between the slightly polluted beta-mesosaprobic and the heavily polluted alpha mesosaprobic zone of Leithe (1975). Going purely by the B O D values alone even station - 2 can be categorised under the heavily polluted alphamesosaprobic zone. The numbers of plankton are however small compared to Leithe's (1975) estimates, but correspond to the findings from sewage fed tanks and anthropogenically eutrophicated waters (George *et al.*, 1985; 1986).

Table 1 : Details of observed Planktonic indicator species and Saprobic index value

Organisms	Value of s	Value of h	s.h.
Nitszchia	3	5	15
Navicula	3	3	9
Gyrosigma	3	4	10
Phormidium	2	5	9
Ceratium	3	3	12

$$s.h. = 55$$
$$h = 20$$
$$S = \frac{s.h.}{h} = \frac{55}{20} = 2.75$$

The resultant saprobic Index value (Table 1) of 2.75 lies between the range of 2.5 and 3.5, wherein the degree of pollution is heavy (alpha-mesosaprobic) according to Pantle and Buck (1955).

The present work conclusively proves saprotrophication of the estuarine areas studied. Saprotrophy is an extreme stage of organic pollution which manifests very quickly in smaller bodies of stagnant water; in rivers, it is prevalent at the point of sewage outfall and may be witnessed for miles downstream if pollution load is beyond the self purification capacity of water (Zutshi, 1981). The present work fully corroborates with this observation.

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REFERENCES

APHA, 1975, *Standard Method for the Examination of Water and Wastewater.* 14th Ed. American Washington, USA.

Basu, A.K., 1970, Biochemical Oxygen Demand : Its chemical reaction, mathematical interpretation and methodology. *Indian J.Fish., XIII* 10:

Bhargava, R.M.S., 1973, Diurnal variation in phytoplankton pigments of Mandovi estuary, Goa, *Indian J. mar. Sci. 2:* 27-31.

Bhargava, R.M.S. and S.N.Dwivedi, 1974, Diurnal variation in phytoplankton pigments in Zuari estuary, Goa, *Indian J. mar. Sci. 3:* 142-145

Bridgwater, A.V. and Mumford, 1979, *Waste Recycling and Pollution Control Handbook* Van Nostrand Reinhold Company, New York, USA, 706 p.

George, J.P., 1985, A.K.Sharma, K.Venkateshvaran, R.K.Sinha G. Venugopal and R.S.Biradar, Length-Weight relationship and relative condition factor in *Cirrhina mrigala* and *Labeo rotia* from a sewage-fed tank. *Ann.* Zool., XIII (2): 79-90.

Kamat, N.D., 1981, Diatoms and diatom populations indicating water quality and pollution. *Proc. Workshop of Biological Indicators and Indices of Environ, Poll. Osmania Univ.,* Hyderabad. Sept. 21-23 : 77-83.

Khan, M.A. and I.S. Rao, 1981, Zooplankton in the evaluation of pollution. *Ibid.,* 1-121-133.

Leithe, W., 1975. *The Analysis of Organic Pollutants in Water and Wastewater* (Eng. Transl.) Ann. Arbor Sc., Publ. Inc., Michigan, USA. 213 p.

Leibman, H., 1962, *Handbuch der Frischwasser und Abwasserbiologie* Vol. I., 2nd Ed., R. Oldenbourg, Munchen, 588 p.

Mahapatra, P.K. and K.K.Dash, 1987, *Diel Rhythm of Biotic and Abiotic Components of Some Brackish Water* Ponds. Unpubl. Dissertation, CEFTC., Kakinada, 40p.

Pantle R., and H. Buck, 1955. Die biologische Uberwachung der Gewasser unddie Dastellung der Erogebnisse. *Gas and Waserfach, 96* - 04

Patrick, R., 1977. Ecology of freshwater diatoms and diatom communities. p. 284-382.*In. The Biology of Diatoms.* (Warner, D., ed. Blackwell Sci. Publ., Oxford, England.

Persoone, G., and N. De Pauw, 1979. Systems of biological indicators for water quality assessment. p. 39-75. *In. Biological Aspects of Freshwater Pollution* (Ravera, O., ed) Pergamon Press, Oxford, England. 214 p.

Qasim, S.Z., and C.K. Gopinathan, 1969. Tidal cycle and environmental features of Cochin backwater (A tropical estuary). *Proc. Ind. Acad. Sci., 69:* 336-348.

Ram M.J., B.N. Desai and S.A.H. Abidi, 1984, Diurnal variation of phytoplankton pigments and population in the nearshore waters of that (Maharashtra). *Mahasagar.* 17: 41-47.

Royal Commission Environmental Pollution, 1972, 3rd Report, Cmnd 5054, HMSO.

Vijayalakśhmi, G.S. and V.K.Venugopalan, 1973. Diurnal variation in physicochemical and biological properties in Vellar estuary. *Indian J. mar. Sci. 2:* 19-22.

Zafar, A.R., 1981, Algological evaluation of water pollution. *Proc. Workshop on Biological Indicators and Indices of Environ. Poll.* Osmani Univ., Sept. 21-23: 67-76.

Zutshi, D.P., 1981. Evaluation of eutrophication in freshwater lakes using phytoplankton and primary production as indicators., *Ibid.*, 85-91.